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GB 2255216 A WO 91/06838 A FR 002774763 A
US 5442669 A

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(54) Abstract Title
Data logging device which determines lifetime of a product

(57) A data logging device (1) that determines the remaining lifetime of a product includes at least one sensor (2) for sensing a factor that effects the lifetime of the product, a data processor (4) and a display means (8). When in use, the data processor (4) monitors the output signal from the sensor (2) and calculates the remaining lifetime of the product taking account of the output signal, and displays the remaining lifetime on the display means (8). The sensors (2) could be arranged to sense one or more of temperature, humidity, gas levels, pH, motion, angle, tilt, inversion, pressure, tension, compression, shock and light.

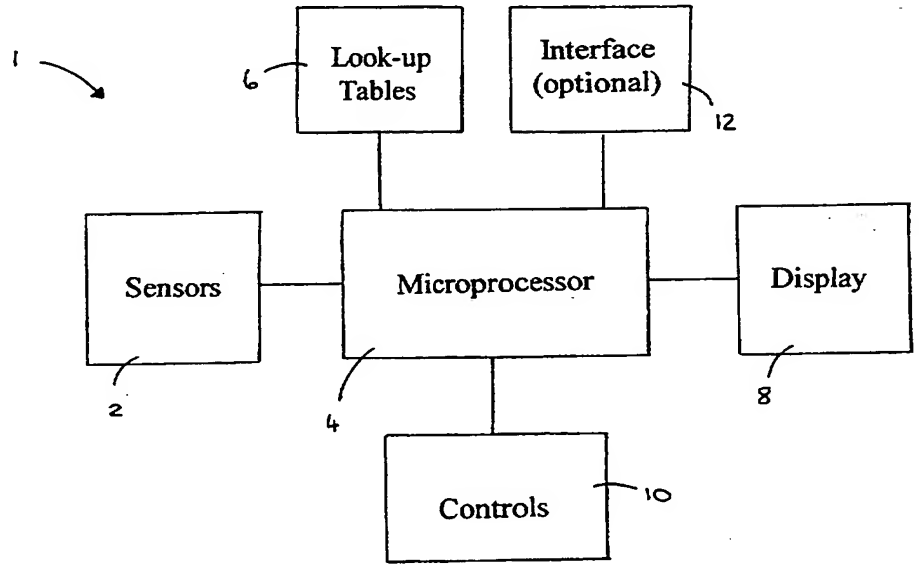

Figure 1

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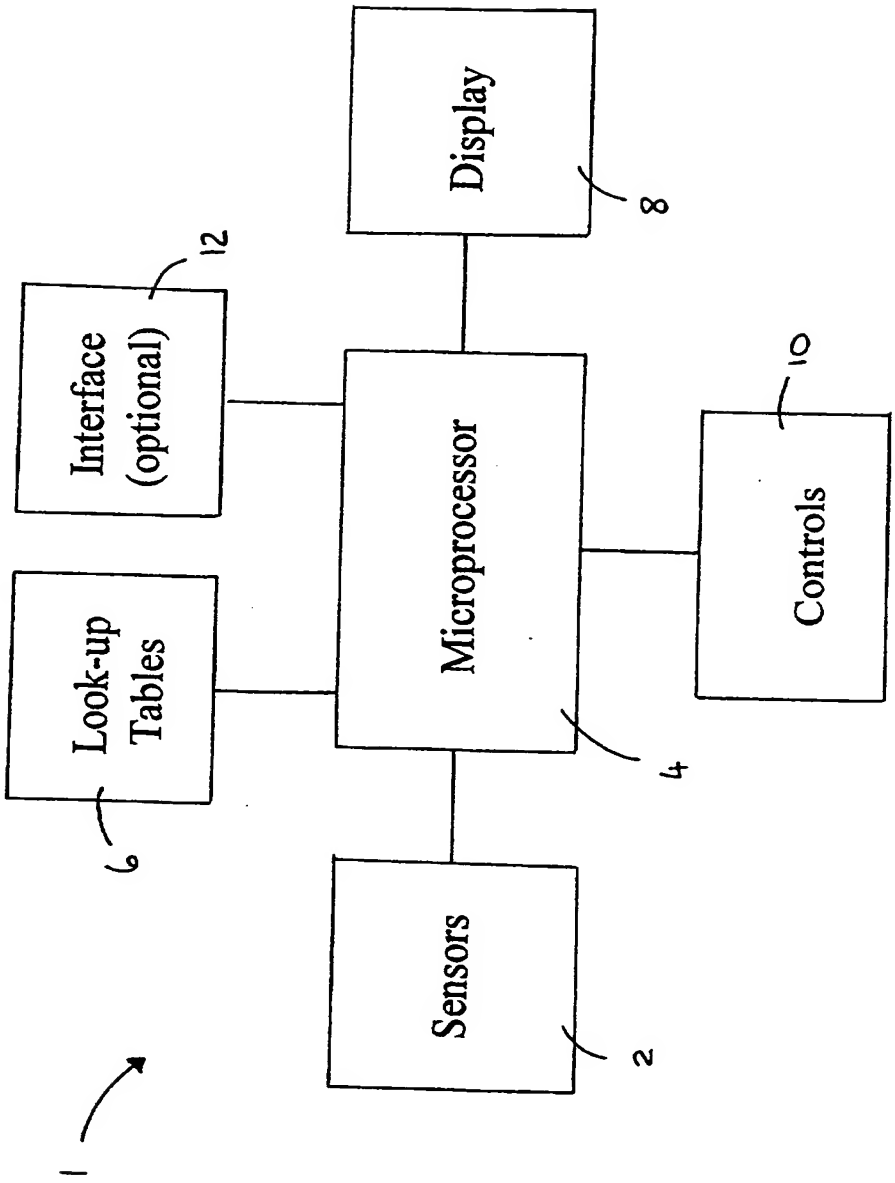

Figure 1

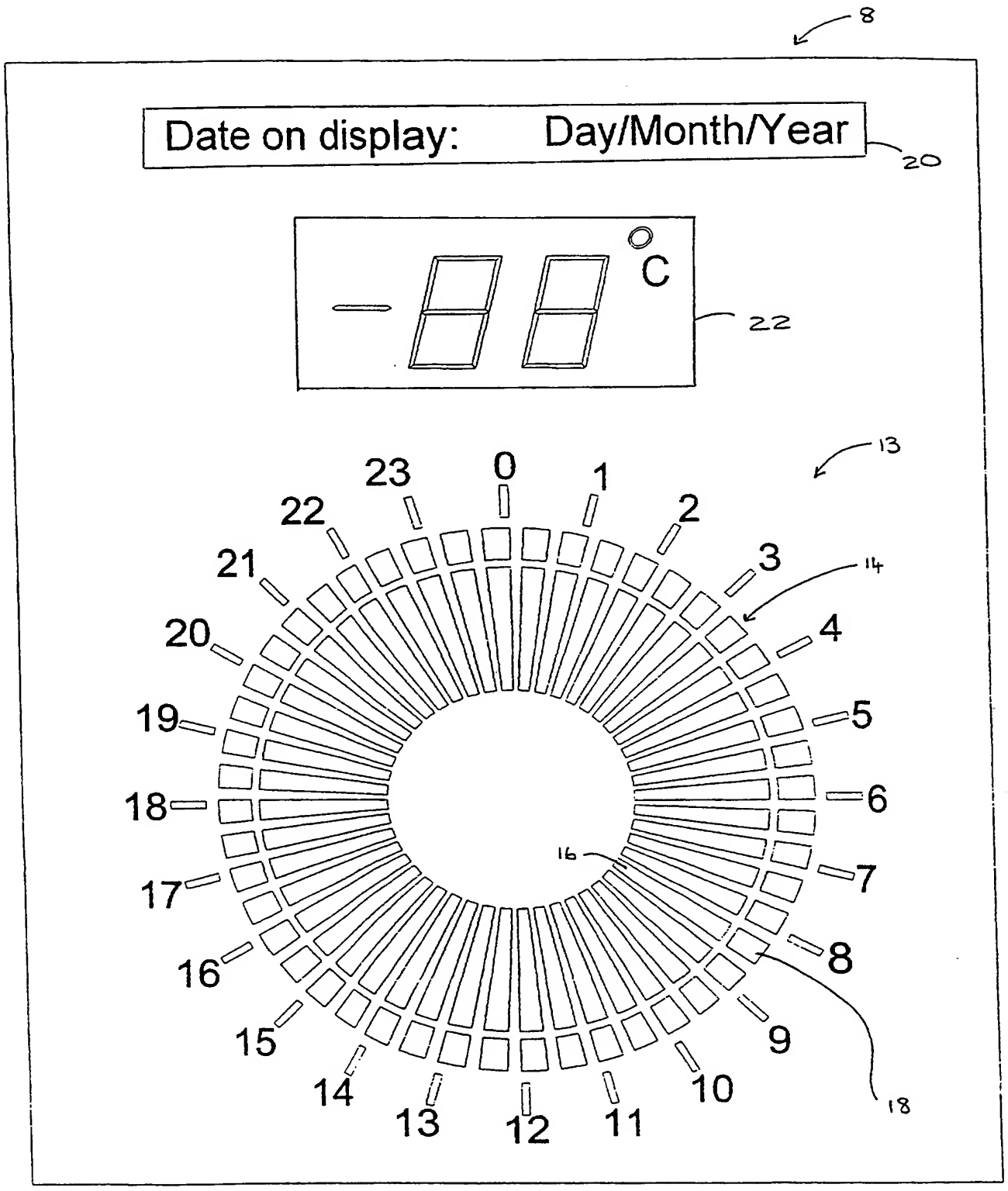
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Figure 2

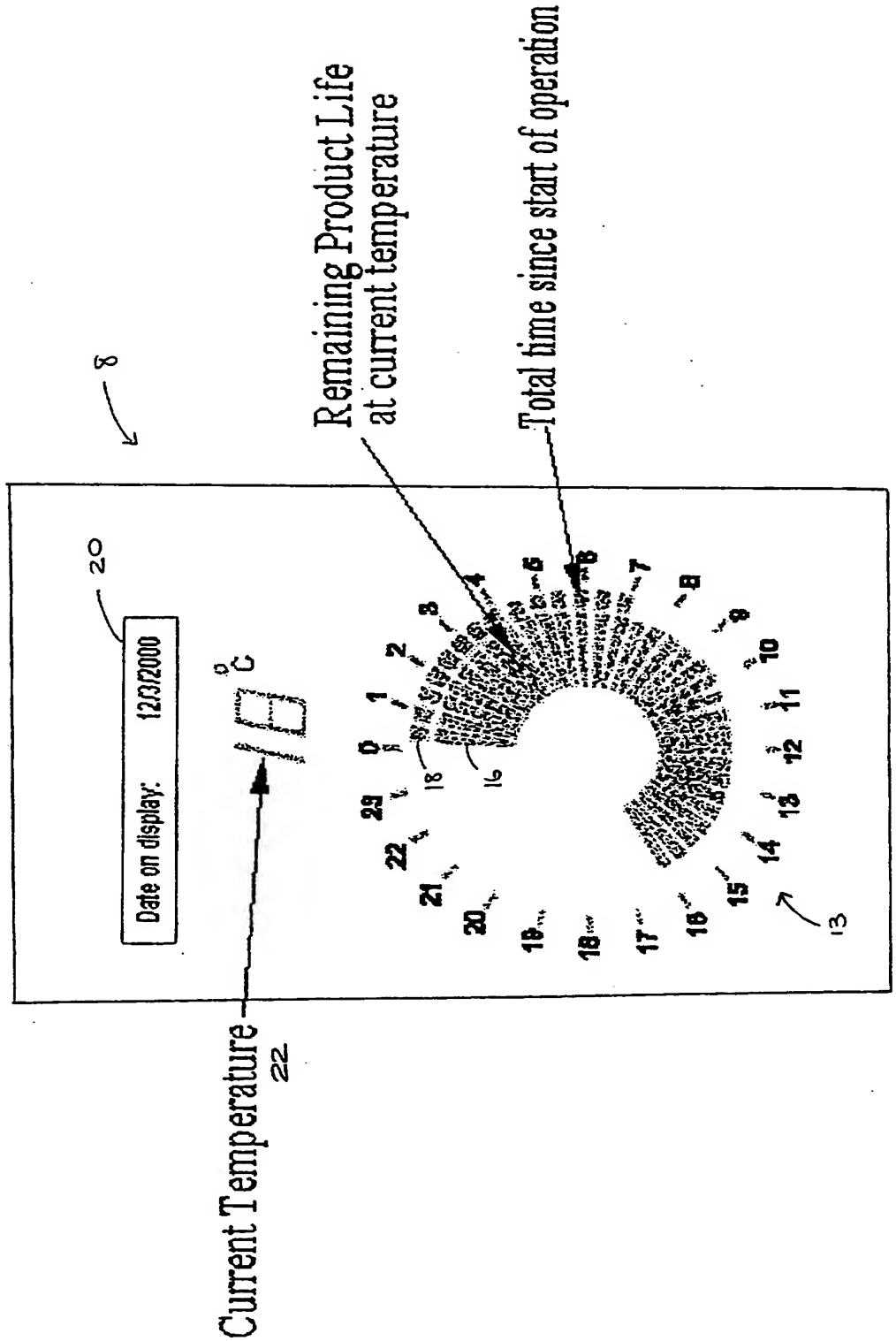

Figure 3

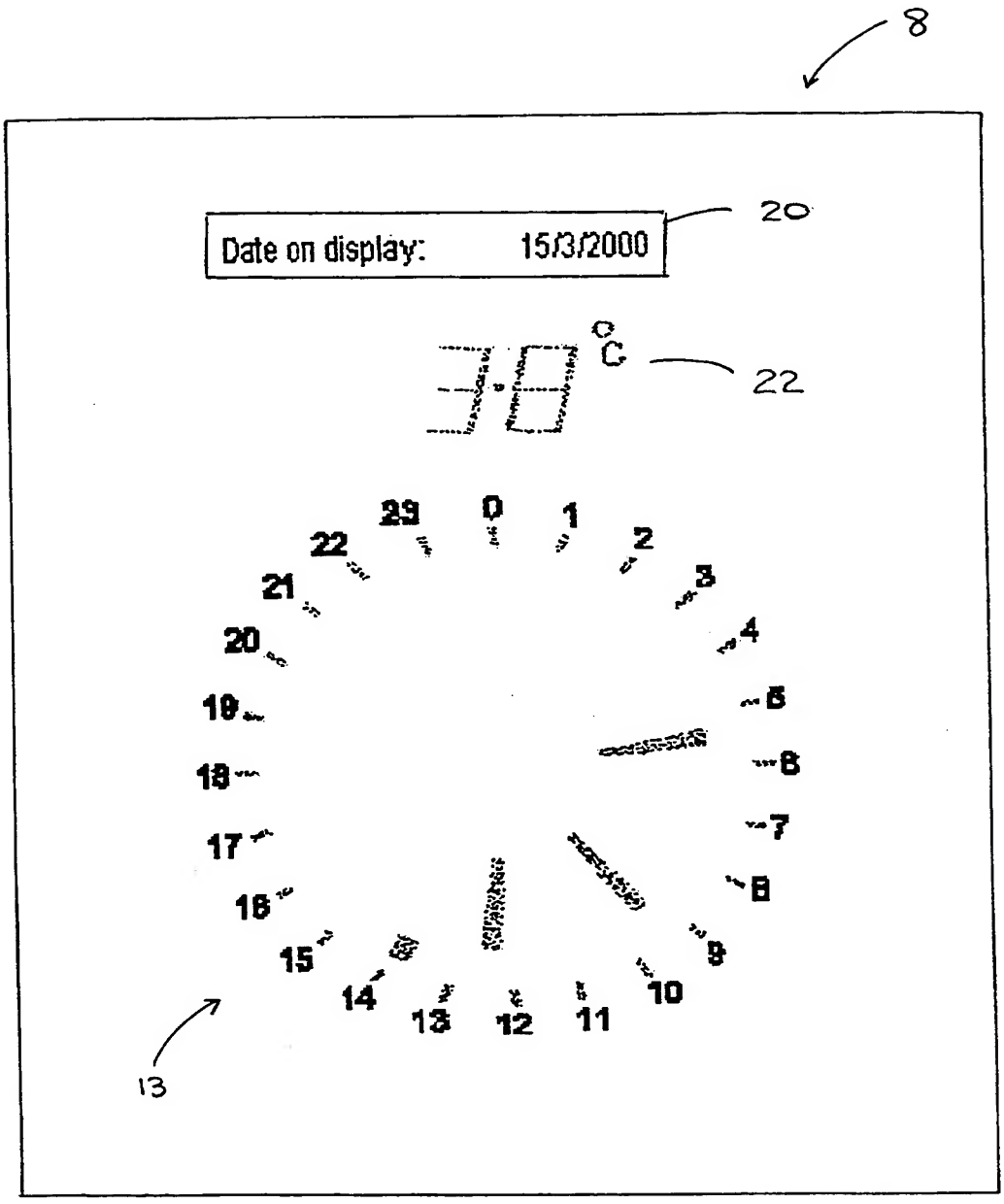
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Figure 4

DATA LOGGING DEVICE

This invention relates to a data logging device, particularly but not exclusively a device that monitors and displays the remaining lifetime of a product.

All objects decay over time at a rate determined by the severity, duration and frequency of known physical, chemical or biological factors to which the object is exposed. The length of an object's useful lifetime therefore depends on these external factors. For example the useful lifetime of chilled food is affected by temperature; vaccines, drugs and biological samples are affected by factors such as temperature, humidity, inversion, tilt, shock, gas level and pH; computer installations are affected by temperature and humidity; and structural components of aircraft are affected by mechanical vibrations and physical forces such as compressive or tensile forces.

For many years "use-by" dates have been marked on products such as chilled foods or pharmaceuticals, to indicate the expected useful lifetime of those products. However, one of the disadvantages of "use-by" dates is that the date is calculated on the assumption that the products are stored in the correct manner. For example, a product's "use-by" date may be calculated on the assumption that the product is always kept within a predetermined temperature range.

For products such as vaccines, which have a short lifetime and are very sensitive to temperature, problems can arise, particularly when the product has to be transported. During transportation, the product may experience very wide fluctuations in ambient temperature. Even though the product may be transported in an insulated container, these temperature fluctuations may be sufficient to affect the lifetime of the product.

This problem was addressed in the applicant's previous patent (GB 2 255 216 B) for a data logger, which includes a temperature sensor for monitoring the temperature of the product and a display to warn of temperature excursions from the predetermined temperature range. The temperature excursions may shorten a product's useful lifetime depending on the severity of the excursion. However, although this data logger provides a warning of such temperature excursions, it does not indicate the extent to which the useful lifetime of the

product has been affected by the excursion. Although the product's lifetime may have been shortened, the product may still be usable.

Other data logging devices are known that monitor and record the required data for analysis at a later stage. The product's remaining useable lifetime can be determined by analysing the data using established degradation tables. However, this method is complicated, time consuming and does not allow an instant assessment of the remaining lifetime.

An object of the present invention is to provide a data logging device that mitigates at least some of the aforementioned problems.

According to the present invention there is provided a data logging device for determining the remaining lifetime of a product, the device including at least one sensor for sensing a factor that affects the lifetime of the product, a data processor and a display means, the data processor being constructed and arranged to monitor an output signal from the sensor and calculate the remaining lifetime of the product taking account of said output signal, and display the remaining lifetime on the display means.

The data logging device calculates and visually displays the remaining lifetime of a product as determined by the output signals received from the sensor measuring a factor that affects the lifetime of the product. There is no need to download the output signals in order to calculate the remaining lifetime.

In this document, the "lifetime" of a product is defined as the period for which the product is considered safe for use. This is not necessarily the same as the time for which the product is actually safe, since this period cannot be predicted precisely. Instead, it is an estimated period, which includes a margin for error to ensure that any risk of the product being used when it is unsafe is minimised.

Advantageously, the device includes electronic look-up tables, the data processor being constructed and arranged to compare the output signal from the sensor with values in look-up tables in order to calculate the remaining lifetime of the product.

Preferably, the data processor includes a clock for measuring elapsed time, and a memory for storing data.

Preferably, the device includes controls for starting and stopping the device, inputting the required data, controlling the data displayed, and/or recalling the stored information.

Preferably the sensor is a temperature sensor. Alternatively, the device includes a plurality of sensors for sensing different factors that affect the lifetime of the product, such as temperature, humidity, gas levels, pH, motion, angle, tilt, inversion, pressure, tension, compression, shock and light.

Advantageously, the display includes a plurality of indicator elements. Preferably, the indicator elements are arranged in a clock-like array. The display may be a liquid crystal display.

Advantageously, the display shows elapsed time. The display may also show excursions from a predetermined range for at least one sensed factor. Preferably, the display is switchable between modes, and may display the current values of at least one sensed factor.

Advantageously, the device includes an interface for downloading and/or uploading data.

Advantageously, the device includes an alarm or warning device. Preferably, the alarm or warning device is audible.

Advantageously, the device is attached to a container. Preferably, the container is insulated.

Embodiments of the present invention will now be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 shows a schematic diagram of a data logging device;

Figure 2 shows a clock-like display of individual equal sized segments;

Figure 3 shows the clock-like display in a first display mode, in which the remaining product life is displayed; and

Figure 4 shows the clock-like display in a second display mode, in which the time periods during which excursions were recorded are displayed.

The invention relates to a data logging device 1 that displays the remaining useful lifetime of a product.

The device 1 comprises a number of components, in particular, one or more sensors 2, a microprocessor 4, electronic look-up tables 6, a display 8, controls 10 and optionally an interface 12.

The sensors 2 measure one or more of the different physical and/or chemical factors that might affect the lifetime of a product, such as temperature, humidity, gas levels, pH, motion, angle, tilt, inversion, pressure, tension, compression, shock and light. In this example, only one sensor is provided, which measures temperature.

The sensor 2 is connected to a microprocessor 4 that monitors and saves the output signal from the sensor. The output signal is compared with the values in the look-up tables 6, and the remaining useable lifetime of the product is calculated. The microprocessor also includes a clock to measure the elapsed time from when the device was started.

The remaining lifetime is displayed on a display 8. The display 8 may also show the elapsed time, or the time periods in which excursions from the predetermined ranges were recorded.

A set of controls 10 is connected to the microprocessor 4. The controls may include for example means for inputting the required data, starting or stopping the device, controlling what data is displayed on the display 8, and recalling the stored information.

An interface 12 may be connected to the microprocessor 4, for downloading or uploading data. For example, data may be downloaded to or uploaded from a computer or modem.

The device may be mounted on a container, for example a refrigerated container or an insulated box.

The display 8, as illustrated in figure 2, will now be described in greater detail. The display includes a clock-like array 13 of Liquid Crystal Display (LCD) elements with forty eight indicators 14 in the form of equal sized segments. The clock-like array represents a time period of twenty four hours and each indicator 14 represents a thirty minute time interval. Each indicator 14 is split into an inner indicator 16 and an outer indicator 18.

A date indicator 20 on the display shows which twenty four hour period is displayed. The number of previous twenty four hour periods for which data has been recorded may be

indicated on the display by means of a number of LEDs (not shown). For each previous cycle, one of the LEDs will illuminate.

The temperature recorded by the sensor 2 may be displayed visually on the display by means of a digital display 22.

The predetermined temperature range within which the product is to remain in order to maximise the useable lifetime may also be displayed (not shown).

As shown in Figure 3, in a first display mode the remaining lifetime is shown by the number of visible inner indicators 16. As the remaining lifetime decreases, so do the number of visible inner indicators 16. The outer indicators 18 are used to display the total time since the start of the operation. Alternatively, the outer indicators may be used to display the time periods in which an excursion from the required temperature range was recorded.

Alternatively, in a second display mode the inner indicators 16 may be used to display the time periods in which an excursion from the temperature range was recorded, as shown in figure 4. The outer indicators 18 again display the total time since the start of the operation. The operator can use the control panel 10 to switch between the display modes depending on the data of interest.

Use of the device will be described by way of an example relating to use of the device for monitoring the condition of chilled food in transit. However, as described above many other uses of the device are envisaged and the present description is given only by way of example.

Chilled food must be stored at a temperature not less than -1 °C and not more than 5 °C. If the temperature remains within this range, the product life will be maximised. If, however, the temperature rises above or falls below the desired range, the product life will be reduced.

The remaining lifetime of a product is calculated from the sensor's output signal, in this case the recorded temperature. If the temperature recorded by the sensor remains within the predetermined temperature range, the product will degrade slowly and the displayed

lifetime of the product will be maximised. If, however, the temperature is outside the predetermined range, the product will degrade more quickly and the displayed lifetime will be reduced. In the event that the temperature returns to the predetermined range, the rate of degradation will decrease and the displayed lifetime may increase.

The operator can enter the initial data relating to, for example, the product and the required temperature range using the controls. Alternatively, the data can be uploaded through an interface 12. The product is then placed in a container and the logger is started. During operation, the logger monitors the temperature, looks up the rate of decay from the degradation tables and calculates the remaining lifetime of the product. The remaining lifetime is then visually displayed on the display. The data is also stored for downloading and analysis at a later stage.

When the destination is reached or during transit, the operator only has to look at the display to see the lifetime remaining.

Various modifications of the present invention are envisaged. For example a different format of the display may be used, such as a digital display. Different external factors and criteria, other than temperature, may be monitored and displayed. An alarm or warning device may be included to alert the operator that the useful lifetime of a product has expired or is about to expire. The alarm or warning device may be visual or audible.

CLAIMS:

1. A data logging device for determining the remaining lifetime of a product, the device including at least one sensor for sensing a factor that affects the lifetime of the product, a data processor and a display means, the data processor being constructed and arranged to monitor an output signal from the sensor and calculate the remaining lifetime of the product taking account of said output signal, and display the remaining lifetime on the display means.

2. A data logging device according to claim 1, wherein the device includes electronic look-up tables, the data processor being constructed and arranged to compare the output signal from the sensor with values in look-up tables in order to calculate the remaining lifetime of the product.

3. A data logging device according to claim 1 or claim 2, wherein the data processor includes a clock for measuring elapsed time.

4. A data logging device according to any one of the preceding claims, wherein the data processor includes a memory for storing data.

5. A data logging device according to any one of the preceding claims, wherein the device includes a start/stop control.

6. A data logging device according to any one of the preceding claims, wherein the device includes a control for inputting the required data.

7. A data logging device according to any one of the preceding claims, wherein the device includes a control for controlling the data displayed.

8. A data logging device according to any one of the preceding claims, wherein the sensor is a temperature sensor.

9. A data logging device according to any one of the preceding claims, wherein the device includes a plurality of sensors for sensing different factors that affect the lifetime of the product.

10. A data logging device according to claim 9, wherein the sensors sense one or more of temperature, humidity, gas levels, pH, motion, angle, tilt, inversion, pressure, tension, compression, shock and light.

11. A data logging device according to any of the preceding claims, wherein the display includes a plurality of indicator elements.

12. A data logging device according to claim 11, wherein the indicator elements are arranged in a clock-like array.

13. A data logging device according to claim 11 or claim 12, wherein the display includes a liquid crystal display.

14. A data logging device according to any of the preceding claims, wherein the display is arranged to show elapsed time.

15. A data logging device according to any of the preceding claims, wherein the display is arranged to show excursions from a predetermined range for at least one sensed factor.

16. A data logging device according to any of the preceding claims, wherein the display is switchable between modes.

17. A data logging device according to any of the preceding claims, wherein the display displays the current values of at least one sensed factor.

18. A data logging device according to any of the preceding claims, wherein the device includes an interface for downloading and/or uploading data.

19. A data logging device according to any of the preceding claims, wherein the device includes an alarm or warning device.

20. A data logging device according to claim 19, wherein the alarm or warning device is audible.

21. A data logging device substantially as described herein with reference to the accompanying drawings.

22. A container including a data logging device as defined by any one of the preceding claims.

23. A container according to claim 22, wherein the container is insulated.